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The association between smartphone usage and musculoskeletal pain among medical residents in Riyadh, Saudi Arabia during covid-19 pandemic

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ABSTRACT

Background: The association between smartphone addiction and the increased prevalence of musculoskeletal pain is still a controversial issue. The present study aimed at investigating the association between smartphone addiction and musculoskeletal pain among medical residents in Riyadh city, Saudi Arabia during COVID-19 pandemic. *Methods*: This study was cross-sectional that included a 3-part questionnaire over a sample of 195 medical residents. The questionnaire consisted of participants' demographic data, Smartphone Addiction Scale – Short Version (SAS-SV), and "the Nordic Musculoskeletal Questionnaire (NMQ)". *Results*: The prevalence of musculoskeletal pain among the study participants was as following: neck (69.7%), shoulder (75.9%), Elbow (26.2%), wrists/hands (82.1%), upper back (72.3%), and lower back (91.8%). There were significant statistical differences in smartphone addiction scores in favor of the medical residents who had shoulder pain (p=0.000), wrists/hands pain (p=0.000), and neck pain (p=0.000). The SAS-SV score were significantly correlated to the participants' duration of exercises (r=-0.305, p=0.037), neck pain (r=0.419, p=0.000), shoulder pain (r=0.261, p=0.029), wrists/hands pain (r=0.618, p=0.000), upper back pain (r=0.207, p=0.016), and lower back pain (r=0.138, p=0.000). Finally, it was found that the smartphone addiction score significantly predicting the neck pain (OR=2.36, CI: 0.58-2.44, p=0.000), upper back pain (OR=2.68, CI=0.50-3.11, p=0.000), lower back pain (OR=2.30, CI=0.84-3.51, p=0.000), shoulder pain (OR=2.69, CI: 0.41-3.01, p=0.002), Elbow pain (OR=2.15, CI: 0.80-2.94, p=0.027), and wrists/hands pain (OR=2.97, CI: 1.51-4.18, p=0.001). *Conclusion*: The study concluded that smartphone addiction is significantly associated with a higher prevalence of musculoskeletal pain in the neck, shoulders, elbow, wrists/hands, lower back, and upper back.

Keywords: Smartphone addiction, musculoskeletal pain, Medical residents, Riyadh

1. INTRODUCTION

As the world progressively grows digital every day, technologies being involved in every person's life and evolving, its sub-hazards need to be well studied and understood. Almost every human currently has a smartphone, defined as a Mobile handheld device with advanced computing capabilities, such as internet communication, information retrieval, video, e-commerce, social networking, and other capabilities (Ko et al., 2013). A study in 2012 revealed that there were more than six billion smartphone users worldwide (International Telecommunication Union, 2012). According to the Ministry of Communication and Information Technology, In Saudi Arabia, a newly published survey found that the kingdom has the highest number of mobile phone users than any other country in the world (Alosaimi et al., 2016). Most adults and youth have two devices. Another survey conducted under the umbrella of the United Nations (UN) conference on trade and development revealed 188 registered mobile phones for every 100 Saudis in the kingdom.

Addiction refers to drug or substance abuse, but it also refers to gambling, the internet, games, and a newly diagnosed term, Smartphone Addiction, an increasing issue in the populations that lies under the behavioral addiction category (Lee, 2006), affecting users both physically and psychologically. For example, in 2014-2015, in a study done among 2367 Saudi university students, 27.2 percent said they used their phone for more than eight hours each day, while 75% said they used it for 4 hours per day (Alosaimi et al., 2016). Another study conducted in 2016 to assess mobile phone use among 133 medical residents in 17 different specialties found that 99.0 percent of participants were mobile phone users with a mean duration of use of 5.12 (SD 2.4) years, with WhatsApp being the most popular application, as well as its use in medical practice, such as drugs, medical references, and medical calculation apps (Dolan & Green, 2006).

Smartphones' usage usually causes the individuals to adopt an unnatural position, which leads to increasing the risks of musculoskeletal abnormalities and pain due to activating the muscles and degenerating the ligament (Dolan & Green, 2006; McGill & Brown, 1992). Body parts that are most commonly involved in the usage of smartphones are fingers, cervical, back, and shoulders. These regions are mostly affected by smartphone addiction (Korpinen & Pääkkönen, 2011). Negative effects include but are not limited to nervous system disturbances, weakening of the immune system, problems in the musculoskeletal system, cancer, and sleep disorders (Cha & Seo, 2018). As touchscreen smartphones have massively replaced most keypad phones, because the included applications in smartphones are versatile and abundant, it is a growing concern for having prolonged use causing substantial load on the postural muscles and spine, and the touch action that is sometimes performed with high speed and high repetition rates (Ko et al., 2013; Negley, 2014). Smartphones are unlike any conventional telephones. Its development led to rapid societal changes by having everything operated and centered on it for the user's convenience; its countless vast services and connective speed. Several studies have reported musculoskeletal problems in workers using desktop computers (Ko et al., 2013; Jognston et al., 2008); therefore, it is reported as a significant medical topic to investigate how smartphone addiction is associated to musculoskeletal symptoms (Kietrys et al., 2007).

A systematic review published in 2018 by Eitivipart, discussing the musculoskeletal disorders resulting from prolonged use of smartphones, where 12 studies were eligible for the review from 639 potentially relevant studies, revealed that the use of smartphones might contribute to the occurrence of clinical and subclinical musculoskeletal changes, and recommended for future research to use publication guidelines to improve study design. Locally, a more recent study done by Alsalameh et al., (2019) in Qassim, Saudi Arabia adopted the (SAS-SV) and (NMQ) questionnaires on 242 medical students, the prevalence of smartphones addiction reached up to 60.3%, with a highest rate of neck pain (60.8%), then the lower back (46.8%) and shoulders (40.0%), and recommended for further research to validate the findings due to the limited published papers here in Saudi Arabia.

Moreover, in 2017, Tonga studied the relationship among 349 university students, using (RULA) for muscle pain and (SAS) for smartphone addiction. 43% of students were using their smartphones for more than 4 hours. The most frequent symptoms were found in the neck (59.6%), shoulders (51.82%), and upper back (54.4%) regions. Nevertheless, in an observational cross-sectional study by Damasceno et al., (2018) in Brazil, 150 young adults using the young spine questionnaire to evaluate neck pain showed no correlation between texting and neck pain or frequency of neck pain. These findings challenged the belief that inappropriate neck posture during smartphone texting is causing the high prevalence of neck pain.

A study by Yang et al., (2017) in Tawain showed that smartphone use and musculoskeletal discomfort on adolescent students were related to the duration of time spent talking on the phone as a predictor of upper back discomfort. Furthermore, a few studies indicated a relationship to LCD screens. The smaller the screen, the more bending angles of the neck increase, the highly likely

chance of musculoskeletal symptoms to erupt, and of course, on the contrary, the larger the LCD screen, the more comfort and convenience it will be, resulting in a reduction of the complaint rate (Kim et al., 2015; Lee, 2002).

This study aimed primarily at measuring how the prolonged use of smartphones is associated to musculoskeletal pain among Medical Residents in Riyadh, Saudi Arabia, during COVID-19 times. In addition, this study sought to identify the factors predicting musculoskeletal pain among medical residents in Riyadh city.

2. METHOD

The present study was a cross-sectional survey performed between May/2020 and May/2021.

Research participants and settings

The present study was performed over the family medicine residents in Riyadh's private and public hospitals. The inclusion criteria involved being a family medicine resident in Riyadh city, aged 24 to 35 years and who will to take part in the study. However, the medical residents who had an experience of trauma, fracture, or surgery to cervical, thoracic and shoulder area, spine deformity, or connective tissue disorder were unwilling to participate or not within the age range set for this excluded from the present study.

The estimated sample size was based on G*power 3.1.9.2 software with related z test, Odds Ratio of 2.00, $\alpha \leq 0.05$, a critical z of 1.96, the sample size of 180 participants was found to give a power of 0.95. Ten percent were added to the total number to avoid the dropout of the participants and technical problem-related issues during data collection. As a result, the current study was able to recruit a total of 200 individuals successfully. However, during the data analysis process, a total of 195 surveys were eligible. As a result, the total sample size in this study was 195 participants.

Data Collection Instruments

The study used the questionnaire as a data collection tool. The study questionnaire comprised of 3 distinct parts, as following:

Part I: The demographic characteristics of the study participants, which included the participants' age, gender, level of residency, weight, height, Body Mass Index (BMI), and frequency of exercising.

Part II: The Smartphone Addiction Scale- Short Version (SAS-SV), which is developed by Kown and consists of 10 items scale through a 6-point Likert scale ranging from strongly disagree (1) to strongly agree (6). The scale's total score was compared to a cut-off score of 31 for males and 33 for females.

Part III: "The Nordic Musculoskeletal Questionnaire (NMQ)" developed by Kuorinka et al., (1987) to compare musculoskeletal pain in different body parts in epidemiological studies. The questionnaire consists of two sections; the first section consists of 40 forced-choice items identifying body areas causing musculoskeletal problems. The second section includes additional questions about the neck, the shoulders, and the lower back, further detail relevant issues.

Data Collection

The researchers obtained the Institutional Review Board (IRB) approval to conduct the study (No. 20/0971/IRB), the official approval from the data collection tools developers, and prepared the online questionnaire through uploading the questionnaire into a Google form. The questionnaire link was sent to the possible participants through social media platforms, and they were asked kindly to fill the consent form before getting access to the study questionnaire. Finally, those who were eligible to participate were transferred to the questionnaire form.

The Statistical Package of Social Sciences (SPSS) (v.26.0, IBM Corp, New York, USA) was used to analyze the study participants' responses. Gathered data were checked for completeness, coded, and transferred into the SPSS program. Descriptive statistics (frequencies, percentages, means, and standard deviations) described the participants' characteristics. In addition, both frequencies and percentages were used to measure the prevalence of musculoskeletal disorders among the study participants. Moreover, means and standard deviations were used to measure the smartphone addiction score among different study groups based on pain in different body parts. The Independent samples t-test was used to compare smartphone addiction scores based on the presence or absence of pain in different body parts. Pearson correlation coefficient and point-biserial Pearson correlation were used to assessing the correlation between participants' characteristics and smartphone addiction score. Finally, logistic regression analysis was performed to identify predictors of musculoskeletal pain in body parts. A significance level of ($\alpha \leq 0.05$) was used as a statistical threshold in the present study.

3. RESULTS

A total of 195 participants filled in the study questionnaire. The results shown in table (1) indicated that the mean age of the study participants was (27.6± 1.16). Male participants constituted 53.3% (n=104) whereas females were 46.7% (n=91). Level four medical residents were the highest represented category, as they constituted 32.8% (n=64), whereas the lowest represented category of medical residents were those in the fifth level (4.1%, n=8). About 76.9% (n=150) reported that they exercise daily. In addition, the mean hours of attending weekly online academic activities among the study participants were (5.7±3.35) hours. The participants' mean weight, height, and BMI were (74.4±19.70), (168.2±8.30), and (25.9±5.14), respectively.

Table 1 socio demographic characteristics of the recruited medical residents (n=195)

Variable	M±SD	F (%)
Age`	27.6± 1.16	
Gender		
Male		104 (53.3)
Female		91 (46.7)
Year of Residency		
R1		11 (5.6)
R2		55 (28.2)
R3		57 (29.2)
R4		64 (32.8)
R5		8 (4.1)
Do you exercise on daily basis?		
Yes		45 (23.1)
No		150 (76.9)
On Average, how many hours during the week you attend an online academic activity?	5.7±3.35	
Weight	74.4±19.70	
Height	168.2±8.30	
BMI	25.9±5.14	

The results presented in table (2) represent the prevalence of musculoskeletal pain during the past 12 months and the past Week among the recruited medical students. The results showed that during the past 12 months, neck pain was prevalent among 69.7% of the study participants, whereas shoulder and elbow pain was prevalent among 75.9% and 26.2%, respectively. In addition, wrists/hands, upper back, and lower back pain were prevalent among 82.1%, 72.3%, and 91.8%, respectively. On the other hand, neck pain was prevalent among 41.5% during the past Week, shoulder pain was prevalent among 39.5%, Elbow pain was prevalent among 9.2%, and wrists/hands were prevalent among 68.2%. In addition, the results indicated that upper back and lower back pain were prevalent among 42.1% and 73.8%, respectively.

Furthermore, according to the findings, neck pain stopped 39% of survey participants from conducting their normal work (at home or away from home) in the previous year. In addition, it was found that shoulder pain and Elbow pain prevented 26.2% and 5.6%, respectively, of the participating medical residents from doing their normal work (at home or away from home) during the past year. Finally, the results showed that wrists/hands pain prevented the participating medical residents from doing their routine work (at home or away from home) in the past year, whereas the upper back and lower back pain prevented 31.3% and 45.6% of the recruited medical residents from doing their normal work, respectively (Figure 1).

Table 2 Prevalence of musculoskeletal pain during past 12 months and past week among the recruited medical students

Body part	Past Year Musculoskeletal pain	Past Week Musculoskeletal pain	Prevented you from doing your normal work (at home or away from home) during the past year
Neck	136 (69.7)	81 (41.5)	76 (39)
Shoulder	148 (75.9)	77 (39.5)	51 (26.2)

Body part	Past Year Musculoskeletal pain	Past Week Musculoskeletal pain	Prevented you from doing your normal work (at home or away from home) during the past year
Elbow	51 (26.2)	18 (9.2)	11 (5.6)
Wrists/hands	160 (82.1)	133 (68.2)	63 (32.3)
Upper Back	141 (72.3)	82 (42.1)	61 (31.3)
Lower Back	179 (91.8)	144 (73.8)	89 (45.6)

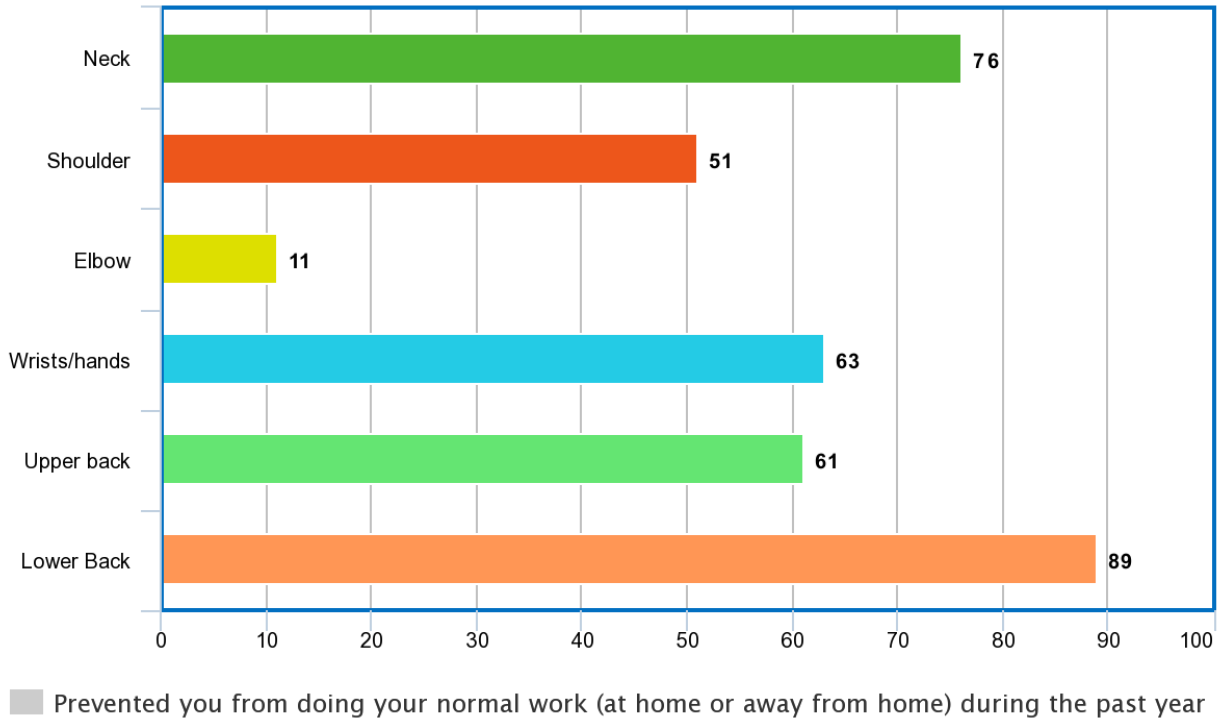

Figure 1 The effect of musculoskeletal pain during the past 12 months

Table 3 Comparison of SAS-SV scores and presence or absence in six body parts

Body part	Pain	SAS-SV score	t-score	P value[a]
Shoulder	(+)	34.16±4.04	9.1068	0.000
	(-)	28.24±3.33		
Elbow	(+)	27.21±3.44	1.5556	0.1214
	(-)	25.91±5.60		
Wrists/Hands	(+)	39.05±5.18	8.3732	0.000
	(-)	30.26±7.36		
Neck	(+)	36.07±6.51	6.7774	0.000
	(-)	29.50±5.48		
Upper Back	(+)	27.19±7.79	1.7067	0.0895
	(-)	25.26±4.64		
Lower Back	(+)	31.66±5.54	0.3661	0.7147
	(-)	32.18±4.14		

[a]Independent samples t-test

(+): Yes, (-): No

The results presented in table (3) represent independent samples t-test for the differences in the smartphone addiction scores based on the absence or presence of pain in the studies' body parts. The results showed that there were significant statistical differences in smartphone addiction scores between the study participants in favor of those who had shoulder pain (t=9.1068,

p=0.000), wrists/hands pain (t=8.3732, p=0.000), and neck pain (t=6.7774, p=0.000). However, no significant statistical differences were found when comparing the study participants who had or had not Elbow (t=1.5556, p=0.1214), upper back (t=1.7067, p=0.0895) or lower back pain (t=0.3661, p=0.7147).

The results presented in table (4) showed that there was significant correlation between the participants' SAS-SV scores and duration of exercises (r=-0.305, p=0.037), neck pain (rbp=0.419, p=0.000), shoulder pain (rbp=0.261, p=0.029), wrists/hands pain (rbp=0.618, p=0.000), upper back pain (rbp=0.207, p=0.016), and lower back pain (rbp0.138, p=0.000).

Table 4 The correlation between SAS-SV scores and participants' characteristics, smartphone usage, and musculoskeletal pain prevalence of the body parts

Variable	SAS-SV score	
	[r] or [r]bp	P value
Age	0.039	0.126[a]
Gender	0.024	0.309[b]
Residency level	0.108	0.117[b]
Duration of exercises	-0.305	0.037[a]
Neck	0.419	0.000b
Shoulder	0.261	0.029[b]
Elbow	0.133	0.068[b]
Wrists/Hands	0.618	0.000[b]
Upper Back	0.207	0.016[b]
Lower Back	0.138	0.000[b]

SAS-SV: Smartphone Addiction Scale – Short Version

[a] Pearson's correlation coefficient, [b] Point-Biserial correlation

The results shown in tables (5 and 6) revealed that the prevalence of musculoskeletal pain during the past 12 months in the neck (OR=1.64, CI: 0.71-2.14, p=0.038), upper back (OR= 1.96, CI=1.05-6.24, p=0.019), lower back (OR=2.27, CI: 0.44-3.46, p=0.000), shoulder (OR=1.88, CI=0.55-4.16, p=0.017), Elbow (OR=2.07, CI: 0.71-4.11, p=0.008), and Wrists/hand (OR=2.21, CI: 0.84-3.15, p=0.048) was significantly lower among males compared to female participants. In addition, it was found that exercising for more than 6 hours was significantly associated with less musculoskeletal pain in the neck (OR=1.05, CI:0.41-2.66, p=0.008), upper back (OR= 1.33, CI=0.80-3.51, p=0.029), lower back (OR=1.21, CI: 0.72-5.41, p=0.031), shoulder (OR=1.40, CI=0.98-3.57, p=0.033), Elbow (OR=1.41, CI: 1.01-4.21, p=0.000), and Wrists/hand (OR=1.52, CI: 0.46-2.81, p=0.000).

Moreover, it was found that higher musculoskeletal pain in the neck (OR=2.51, CI:1.37-4.88, p=0.001), Elbow (OR=2.91, CI: 0.77-5.08, p=0.029), and wrists/hands (OR=2.61, CI: 0.59-4.18, p=0.000) was associated with fourth level residency, whereas upper back pain (OR=2.66, CI:1.17-3.59, p=0.000), lower back pain (OR=2.91, CI: 1.33-4.21, p=0.037), and shoulder pain (OR=2.88, CI: 1.54-4.30, p=0.027) were associated with fifth level residency. Finally, it was found that the smartphone addiction score significantly predicting the neck pain (OR=2.36, CI: 0.58-2.44, p=0.000), upper back pain (OR=2.68, CI=0.50-3.11, p=0.000), lower back pain (OR=2.30, CI=0.84-3.51, p=0.000), shoulder pain (OR=2.69, CI: 0.41-3.01, p=0.002), Elbow pain (OR=2.15, CI: 0.80-2.94, p=0.027), and wrists/hands pain (OR=2.97, CI: 1.51-4.18, p=0.001).

Table 5 Predictors of musculoskeletal pain in body parts (Neck, upper back, lower back)

Predictor	Neck		Upper Back		Lower Back	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Gender						
Female (reference)						
Male	1.64 (0.71-2.14)	0.038	1.96 (1.05-6.24)	0.019	2.27 (0.44-3.46)	0.000
Duration of exercises Less than 6 hours (reference)						
More than 6 hours	1.05 (0.41-2.66)	0.008	1.33 (0.80-3.51)	0.029	1.21 (0.72-5.41)	0.031
Residency level						
R1 (reference)						

Predictor	Neck		Upper Back		Lower Back	
R2	1.33 (0.51-3.21)	0.261	1.66 (1.11-4.36)	0.571	1.86 (0.94-5.33)	0.307
R3	1.18 (0.48-2.51)	0.201	1.79 (0.61-4.03)	0.118	1.30 (0.39-2.66)	0.149
R4	2.51 (1.37-4.88)	0.001	2.16 (1.11-3.56)	0.000	2.63 (0.97-8.41)	0.036
R5	2.28 (1.55-6.04)	0.037	2.66 (1.17-3.59)	0.000	2.91 (1.33-4.21)	0.037
SAS-SV score	2.36 (0.58-2.44)	0.000	2.68 (0.50-3.11)	0.000	2.30 (0.84-3.51)	0.000

Table 6 Predictors of musculoskeletal pain in body parts (Shoulder, Elbow, Wrists/hands)

Predictor	Shoulder		Elbow		Wrists/Hands	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Gender						
Female (reference)						
Male	1.88 (0.55-4.16)	0.017	2.07 (0.71-4.11)	0.008	2.21 (0.84-3.15)	0.048
Duration of exercises Less than 6 hours (reference)						
More than 6 hours	1.40 (0.98-3.57)	0.033	1.41 (1.01-4.21)	0.000	1.52 (0.46-2.81)	0.000
Residency level						
R1 (reference)						
R2	1.09 (0.44-2.18)	0.240	1.81 (1.09-2.73)	0.318	1.96 (0.60-3.51)	0.000
R3	1.73 (1.09-2.70)	0.428	2.07 (0.82-6.21)	0.194	1.38 (0.51-3.16)	0.006
R4	2.36 (1.41-4.84)	0.000	2.91 (0.77-5.08)	0.029	2.61 (0.59-4.18)	0.000
R5	2.88 (1.54-4.30)	0.027	2.36 (1.28-2.91)	0.033	2.55 (0.61-4.22)	0.000
SAS-SV score	2.69 (0.41-3.01)	0.002	2.15 (0.80-2.94)	0.027	2.97 (1.51-4.18)	0.001

4. DISCUSSION

The present study aimed at investigating the association between smartphone usage and musculoskeletal pain among medical residents in Riyadh, Saudi Arabia. The findings of the current investigation showed that there was high prevalence rates of neck, shoulder, elbow, wrists/hands, upper and lower back pain among medical residents, which could be referred to different risk factors as reported by Dighriri et al., (2019) and Algarni et al., (2017), which included the study load of the medical students. The prevalence rates were almost similar to those reported in Dighriri et al., (2019) and Algarni et al., (2017). However, those surveys did not examine the association of smartphone usage with musculoskeletal pain among Saudi medical residents.

The present study's findings showed a significant difference in smartphone usage in favor of the medical residents who had shoulder, wrists/hands, or neck pain. This result could be referred to as that using smartphones mostly requires upper extremity including shoulders, wrists/hands, and neck body parts. This finding was evidenced by the correlation results showing a significant association between smartphone addiction score and shoulder pain, neck pain, wrists/hands pain, and lower back pain. Moreover, the results showed that duration of exercises is inversely correlated to smartphone addiction score, which could be referred to the relieving effect of exercises and its significance of reducing the pain of upper and lower extremities as evidenced by the results reported in Kim et al., (2015) that showed the positive effect of exercises in reducing musculoskeletal pain resulted from smartphone usage.

Moreover, the results of the present study revealed lower musculoskeletal pain among males compared to females, which could be referred to that females are susceptible to other physiological cofactors that might increase the pain intensity, such as menstruation and less practice of physical exercises due to the lack of access to physical exercises facilities. In addition, it was found that advanced residency level increases the risk of developing musculoskeletal pain among medical residents, which might be referred to the increased work and study load exerted over the medical students during the last stages of their residency. Furthermore, this situation exacerbated the COVID-19 pandemic because of the increase in smartphone use to attend online activities and increased frequency of communicating with colleagues through smartphone applications due to social distancing and lockdown circumstances.

A systematic literature review by Xie et al., (2016) had reported a prevalence of musculoskeletal pain among mobile users going from 1 to 68% depending on the body region, with the highest prevalence of complaints in the neck (40.9%). In addition, one of the latest studies conducted by Gustafsson et al., (2017) has shown a cross-sectional association between text messaging and reported

symptoms in the neck and upper extremities (ORs 1.3-2.0). Furthermore, among symptoms at baseline, a prospective association between text messaging and maintained pain in neck/upper back (ORs 2.0) so, demonstrating a link between smartphone usage and neck complaints.

The studies reported several factors that play an important role in musculoskeletal pain due to smartphone use. These factors include individual risk factors such as age, gender differences, and BMI, in addition to physical risk factors that might include static posture, repetitive arm movement, and insufficient rest. In addition, psychosocial risk factors such as stress and depressed mode, pain behavior, and social support were also reported to play a significant role in the prevalence of musculoskeletal pain resulted from smartphone usage (Heredia-Rizo et al., 2020). These factors were reported to cause repetitive biomechanical loading of the upper extremities, neck-shoulder region, and low-back region. These will either lead to some adaptation mechanisms (neck-shoulder structure, low-back structure) or musculoskeletal disorders (neck-shoulder pain, low-back pain).

Despite the significant findings reported in the present study, there are still some limitations that could limit the generalizability of the study findings. First, the present study's design was a cross-sectional research approach, which cannot determine the cause and effect relationship. Therefore, a longitudinal study is needed to assess the cause and effect relationship between smartphone usage and musculoskeletal pain among medical residents during the COVID-19 pandemic. A second limitation is sample limitation, as the present study focused on medical residents from Riyadh city, which might not represent the whole population of medical residents in Saudi Arabia. The present study could be improved by including different geographical regions in Saudi Arabia and medical residents from different healthcare facilities. A third limitation is that smartphone addiction scale scores do not provide a clear clinical diagnosis of smartphone addiction status; rather, it indicates the categories at risk of smartphone addiction.

5. CONCLUSION

To conclude, the present study's findings revealed that medical residents with higher smartphone usage duration are experiencing musculoskeletal pain (neck, shoulder, wrists/hands, upper back, and lower back). Furthermore, the study found that higher scores of smartphone addiction were inversely associated with the duration of exercises. Moreover, it was found that gender, residency level, and smartphone addiction were significant predictors of musculoskeletal pain among medical residents in Riyadh city. Based on the study's findings, the study would recommend conducting a further longitudinal study to assess the relation between smartphones' addiction and musculoskeletal disorders among residents in Saudi Arabia. In addition, the study recommends conducting more awareness campaigns among medical students to increase their knowledge and awareness about the risks of prolonged use of smartphones on developing musculoskeletal disorders.

Authors' contribution

The authors would like to declare that all authors had participated equally in producing this original research paper. The authors equally developed the theoretical framework, formulated the problem statement, implemented the methodology and data collection process, analyzed the participants' responses, and wrote the results and discussion.

Ethical Approval

This study was approved by the Institutional Review Board (IRB) at King Saud University (Ethical approval No. 20/0971/IRB)

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Conflicts of interest

The authors declare that they have no conflict of interest.

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Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

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